

### REMARKS

Claims 61-70 are now presented for examination. Claims 58-60 have been cancelled without prejudice. Claims 61-70 have been added to provide Applicant with a more complete scope of protection.

Claims 61, 67 and 68 are the independent claims.

Claims 58-60 were rejected under 35 U.S.C. § 103 as obvious from U.S. Patent 5,037,621 (Kennedy et al.) in view of U.S. Patent 6,123,764 (Mizugaki et al.). Cancellation of those claims renders their rejection moot.

Applicant submits that the new independent claims are patentable over the prior art for at least the following reasons.

The present invention generally relates to a growth process for producing excellent single crystal, and includes a technique for controlling true crystal growth rate and a technique for maintaining well a shape of the interface between a solid phase and a liquid phase during crystal growth, to suppress formation of stray crystal.

Claim 61 is directed to a process for crystal growth in which a single crystal is grown while solidifying a melted crystal material, using a heat gradient within a temperature range including a melting point of a crystal material to be grown. The process comprises the steps of: detecting an amount of latent heat generated with solidification of the melted crystal material; and controlling a growth rate of crystal based on the amount of latent heat detected.

Claims 67 is directed to a process for crystal growth by using a crystal growth apparatus comprising a crucible for holding a crystal material, a heating means which is capable of forming at the periphery of the crucible a temperature gradient within a temperature range including a melting point of the crystal material, a moving means which

is capable of moving the crucible relatively to the temperature gradient, and a temperature detecting means for detecting a latent heat generated with solidification. The process comprises the steps of: detecting an amount of the latent heat by calculating from a detection result of the temperature detecting means; and moving the moving means such that ratio of the amount of latent heat detected and an area of interface between the melted crystal material and the crystal grown is made almost constant.

As described in the specification, up to now, crystal has been grown by moving crystal to be grown with a constant rate with respect to a temperature distribution in a crystal growth furnace. However, according to this conventional process, continuous solidification is not obtained at a melting point of a crystal material due to the phenomenon of "supercooling" occurring at solidification of the material, and crystal growth proceeds in accordance with discontinuous and abrupt small size solidification, resulting in generation of stray crystal.

By virtue of the process of Claims 61 and 67, since the true crystal growth rate can be made almost constant and the discontinuous and abrupt small size solidification can be suppressed, stray crystal is reduced and good crystal can be grown.

Neither Kennedy nor Mizugaki et al. discussed in previous papers, whether alone or combined, has been found to teach or suggest the process by which the latent heat generated with solidification is detected, and a growth rate of crystal to be grown is controlled based on the amount of the latent heat (Claim 61), or moving means is moved such that a ratio of the amount of latent heat detected to an area of interface between the melted crystal material and the crystal grown is made almost constant (Claim 67). Accordingly, Claims 61 and 67 are believed patentable over the cited references.

The present invention as defined in new Claim 68 and the claims dependent from Claim 68 relates to a growth process using a technique for maintaining well a shape of interface between a solid phase and a liquid phase during crystal growth.

As described in the specification, when crystal is grown in a crucible, the shape of an interface between a portion having been solidified and a portion of melted crystal material is kept convex on the side of the liquid phase, whereby generation of stray crystal can be suppressed. This can be realized by maintaining a higher temperature at the periphery portion compared with the center portion. Up to now various methods have been tried.

However, means for directly controlling a temperature distribution in the cross section have not been known. Further, when a temperature difference in the cross section is made large to obtain the convex shape, strain remains in the crystal grown and the crystal may become broken.

In Claim 68 a detecting means for detecting temperature distribution within a plane of a cross section of the crucible is provided, and a cooling means provided at the center bottom of the crucible and a cooling means provided at the periphery of the crucible, are controlled by the claimed process using the detecting means, such that the desired temperature distribution can be obtained in the cross section of the crucible.

By virtue of the claimed process, since the interface between the solid phase and the liquid phase is made convex on the liquid side, an appropriate temperature distribution can be obtained and stray crystal is suppressed, whereby good crystal growth can be effected.

Neither Kennedy nor Mizugaki et al., alone or combined, has been found to teach or suggest the recited steps of Claim 68. Claim 68 therefore is believed patentable over those references.

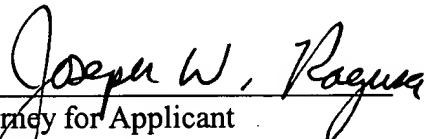
A review of the other art of record has failed to reveal anything which, in Applicant's opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are dependent from the independent claims discussed above and are therefore believed patentable for the same reasons. Since those dependent claims are also deemed to define additional aspects of the invention, however, the individual consideration of their patentability on their own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicant respectfully requests favorable consideration and early passage to issue of the present application.

Applicant's undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

  
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